Survivor: The Space Environment

NASA SUMMER OF INNOVATION

UNIT
Life Science—Survival

GRADE LEVELS
4 – 6

CONNECTION TO CURRICULUM
Science, Technology, and Engineering

TEACHER PREPARATION TIME
1.5 hours

LESSON TIME NEEDED
8 hours *Complexity: Moderate*

DESCRIPTION
Students explore and compare the space environment and Earth's environment to determine the resources needed for humans to survive in both environments.

OBJECTIVES
Students will
- Describe how a change in a population within a food web can have widespread effects on the other populations there
- Create a food and activity plan for healthy eating and modify the plan for 17th-century travel and 21st-century space travel
- Compare the differences in challenges faced by 17th-century and 21st-century explorers
- Construct a model of a DNA molecule
- Understand that DNA can be damaged from radiation
- Investigate the effects of solar UV radiation on an object and analyze the effectiveness of different Sun Protection Factors (SPF)

NATIONAL STANDARDS

National Science Education Standards

Science as Inquiry
- Understanding of scientific concepts
- Abilities necessary to do scientific inquiry
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities, and attitudes associated with science

Life Science
- Characteristics of organisms
- Organisms and environments
- Structure and function in living systems
- Populations and ecosystems
- Diversity and adaptations of organisms

Physical Science
- Transfer of energy

Earth and Space Science
- Structure of the earth system

Science and Technology
- Abilities to distinguish between natural objects and objects made by humans

Science in Personal and Social Perspectives
- Personal health
- Types of resources
- Changes in environments
- Populations, resources, and environments

Science in Personal and Social Perspectives

- Personal health
- Types of resources
- Changes in environments
- Populations, resources, and environments
- Natural hazards
- Risks and benefits
- Science and technology in society

ISTE NETS and Performance Indicators for Students

- Creativity and Innovation
- Apply existing knowledge to generate new ideas, products, or processes
- Use models and simulations to explore complex systems and issues
- Research and Information Fluency
- Process data and report results
- Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
- Critical Thinking, Problem Solving, and Decision Making
- Identify and define authentic problems and significant questions for investigation
- Plan and manage activities to develop a solution or complete a project
- Collect and analyze data to identify solutions and/or make informed decisions
- Use multiple processes and diverse perspectives to explore alternative solutions

MANAGEMENT

Review each activity in this lesson before presenting to students to fully understand content, procedures and requirements needed to successfully complete the activities with the students. You can use the Discussion Questions in this lesson to prepare the students for what they will learn doing the activities. Students should work in small groups for each activity to allow for cooperative learning and sharing of ideas and results. Prepare the materials for each student group before beginning the lesson.

CONTENT RESEARCH

Human beings have certain basic needs. We must have food, water, air, and shelter to survive. If any one of these basic needs is not met, then humans cannot survive. Before past explorers set off to find new lands and conquer new worlds, they had to make sure that their basic needs were met. Supplies of food and water were brought on the journey or were gathered along the way. Shelter, such as a tent, was either carried or built to protect explorers from the weather or other dangers. Basic human needs have not changed much since the 17th century. We continue to explore to better understand our own world and to address the modern challenges that face societies in general. Beyond the boundaries of Earth, 21st-century explorers, with varying backgrounds and careers, will face a unique set of challenges as they work on the International Space Station, return to the Moon, travel to Mars, and scout the far reaches of the solar system.

The lesson is divided into four activities. Each activity contains additional detailed content information to guide the students in their investigations of human survival.

MATERIALS

(Basic materials are listed. Complete list can be found in each activity)

- String or yarn
- Spring-hinge clothespin
- Scissors
- Stopwatch
- Various food samples
- Gum drops (five colors)
- Candy orange slices
- Plain flat toothpicks
- Colored pencils
- Paper towels
- Dark-colored construction paper
- Permanent markers
- Sunscreen (five different SPF's)

Key Concepts:

- Exploring and settling new worlds would be emotionally stressful for both 17th- and 21st-century explorers. Too much emotional stress is not good for anyone.
- Stress from physical activity is necessary for bone growth and maintenance. The body builds bone based on its needs. Muscles also rebuild and grow as a result of physical stress.
- Some current countermeasures for bone and muscle loss during long-duration space flight include nutrition and exercise. Without adequate nutrition, problems can arise for every system in the body.
- Changes in a population within a food web will have widespread effects on the other local populations.
- DNA is the blueprint of life stored in the cells of every organism.
- The Sun's radiation is very powerful and can be dangerous to human beings.

Key Terms:

- **Atrophy:** a decrease in size or wasting away of a body part or tissue
- **DNA**: (deoxyribonucleic acid) the blueprint of life stored in the cells of every organism
- **Food web:** a system of interlocking and interdependent food chains
- **Radiation:** the emission of energy as electromagnetic waves or as moving subatomic particles
- **Solar**: relating to our Sun
- **SPF**: Sun Protection Factor

LESSON ACTIVITIES

Exploration Then and Now—Human Needs

This activity investigates human needs and how humans adapt to new environments. Students experiment to understand the effects of physical stress on muscles. They also identify food properties that make foods suitable for space flight and travel during colonial times. Using the new food-guide pyramid, students create a food and activity plan for healthy eating and then modify this plan based upon what they learn about past and present exploration.
http://www.nasa.gov/pdf/162514main_Human_Needs.pdf

Chain Reaction

This activity demonstrates to students how changes in a population within a food web will have widespread effects on the other local populations.
http://scifiles.larc.nasa.gov/docs/guides/guide3b_01.pdf (page 31)

Solar Radiation and SPF Levels

In this activity, students will investigate the effects solar ultra-violet (UV) radiation has on an object or person and to analyze the effectiveness of different Sun Protection Factors (SPF) found in sunscreen products.
http://scifiles.larc.nasa.gov/educators/episodes/2004_2005/gs_seg3.pdf (page 62)

Modeling Radiation-Damaged DNA

In this activity, students will use candy (or Styrofoam balls) to construct a model of deoxyribonucleic acid (DNA) and will then alter the model to visualize what happens to DNA when it is damaged by radiation.
http://www.nasa.gov/pdf/284277main_Radiation_MS.pdf (page 32)

ADDITIONAL RESOURCES

The activities in this lesson are components of the following curriculum guides that contain additional activities investigating the environmental factors facing space explorers today and those of tomorrow.

Exploration: Then and Now — NASA and Jamestown
http://www.nasa.gov/audience/foreducators/5-8/features/F_Exploration_Then_and_Now.html

Space Faring: The Radiation Challenge
http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/SF_Radiation_Challenge_MS.html

The Case of the Great Space Exploration
http://scifiles.larc.nasa.gov/educators/episodes/2004_2005/gs_seg3.pdf

The Case of the Inhabitable Habitat
http://scifiles.larc.nasa.gov/docs/guides/guide3b_01.pdf

NASA SCI Files (the source for the activities, *The Case of the Great Space Exploration* and *The Case of the Inhabitable Habitat*)
http://scifiles.larc.nasa.gov/

Also, students may want to learn about how animals were the among the first space travelers and helped pave the way for human space exploration.
http://www.nasa.gov/audience/forstudents/9-12/features/F_Animals_in_Space_9-12.html

DISCUSSION QUESTIONS
Begin the lesson with a few questions to stimulate discussion about survival needs here on Earth and in space exploration (answers will vary based on students' prelesson knowledge and should not be considered correct or incorrect, but only to motivate discussion).
- What are the essential items needed for human survival here on Earth? *food, water, air and shelter*
- What are the essential items needed for human survival in space exploration? *food, water, air and shelter*
- Would you like to be a space explorer? Why or why not? *Answers will vary.*
- Why do you think space exploration is important? *Answers will vary*
- What would possibly happen to one of us if our DNA was altered by radiation? *This could cause serious illness or death*
- How can the Sun help us and how can it hurt us? *it is necessary for life on Earth, but without Earth's atmosphere the Sun's radiation can cause serious health problems*

ASSESSMENT ACTIVITIES
- Observe and assess student performance throughout the activities.
- Have each student group report the results of their activities with the class to compare and contrast with other student groups.
- Each individual activity in this lesson contains assessment activities. Refer to those activities for additional assessments.
- Based on what the students learned in the lesson, have them brainstorm a list of items they would need to bring along on a trip to explore Mars or the Moon and explain their answers.
- Research life onboard the International Space Station to see how NASA has addressed survival needs orbiting 300 km above Earth's surface in low Earth orbit.

ENRICHMENT
- Have students determine which careers are necessary for space exploration. They can research NASA careers at: http://www.nasa.gov/audience/forstudents/9-12/career/index.html
- Have students to develop a multimedia presentation that shows the parallels between past and future exploration. They must focus on the theme of human needs but may include other themes of exploration such as transportation, settlement, and populations.
- Have the students investigate and research beneficial uses of radiation such as radiation therapy and nuclear imaging in medicine (CT Scans or PET Scans).